

Governor's Upper Yellowstone River Task Force

Meeting Summary

December 12, 2002

Yellowstone Motor Inn

Meeting began at 7:00 p.m.

I. Introductions

Members Present:

John Bailey, Chair
Dave Haug, Vice Chair
Roy Aserlind
Andy Dana

Doug Ensign
Michelle Goodwine
Jerry O'Hair
Brant Oswald

Rod Siring
Bob Wiltshire
Ellen Woodbury
Jim Woodhull

Ken Britton, USFS Ex-Officio
Tom Olliff, YNP Ex-Officio
Tom Osen, USFS Ex-Officio
Robert Ray, DEQ Ex-Officio

Laurence Siroky, DNRC Ex-Officio
Allan Steinle, Corps Ex-Officio
Stan Sternberg, MDT Ex-Officio
Joel Tohtz, FWP Ex-Officio

Others Present:

Liz Galli-Noble, Coordinator
Kelly Wade, Secretary
Duncan Patten, TAC Chair
Jack Stults
Jim Barrett
Deon Lackey
John Remus
Jeff McClenathan
Mary Frieze
Doug Mann
Tom Arrandale
Burt Williams
Dennis Flath
Ed Schilling
Paul Hook

Karl Biastoch
Brad Shepard
David Marshall
Thomas Hallin
Diane Taliaferro
Scott Compton
Doug Clemerson
Dan Gravage
Chris Hart
Lurah Klaas
Dwight Hines
Mike Gilbert
Jim Robinson
Karen Williams
Dewitt Dominick

Bill Moser
Eric Morrison
Karin Boyd
Zack Bowen
Peter Story
Chuck Parrett
Daryl Smith
Paula Clawson
Tom Pick
Mike Merigiano
Steve Holnbeck
Don Becker
Chuck Dalby
Galen Ibes

II. Prior Meeting Minutes

John Bailey: Any discussion on the minutes of November 19, 2002?

Jerry O'Hair moved to approve the November 19, 2002 minutes as written. Michelle Goodwine seconded the motion. The motion passed unanimously.

III. Financial Updates:

Liz Galli-Noble was unable to present financial updates.

IV. Research Presentation #4. Geomorphology Study

NOTE: This presentation was videotaped and may be viewed upon request. Contact the Task Force coordinator if you wish to borrow the videotape.

1. Introduction

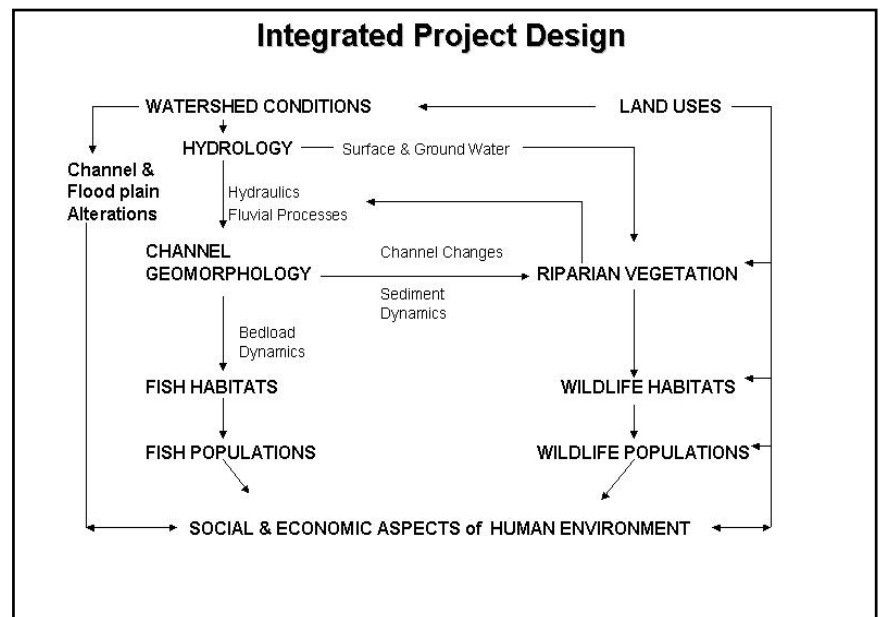
John Bailey: Tonight we will be hearing from one of our scientific research teams. Some of you haven't been to previous Task Force meetings and are new to this process, so I will begin by going over the

format that the Task Force has set for these meetings. We ask that there are no questions or interruptions of the research team while they are making their presentation. When they are done with the formal presentation, there will be a two-part question and answer session. First, the Task Force members will have the opportunity to ask questions of the research, and it has to be specific to the research. Then after the Task Force has had a period of time, which is more or less set by me, then we will allow the public to ask questions. Please be warned that you will be ruled out of order if you start asking the researcher to speculate or answer questions about other subjects that have nothing to do with the geomorphology study.

After the question and answer session, we will go into a second, open discussion session. This will be a general discussion about what was presented, and what it might mean. Again, the Task Force members will be asked to comment first, and then we'll open it up to the public. We certainly want to hear from the public, but this format is partly set up to assist the Task Force in our decision-making and recommendation process. Time is short and we want to make sure that we hear all of the research findings and get at least some understanding of what it means at this meeting; but we certainly want to hear from the public and we certainly will hear from you.

I now would like to introduce Dr. Duncan Patten, the Chair of the Technical Advisory Committee, who will then introduce the researchers for tonight.

Duncan Patten: The reason for showing you this integrated project design is because it illustrates how we've moved along in our research presentations. Last time we were looking at hydraulics and some of the processes that are going on in the channel, which is essentially this portion here, driven by hydrology and the amount of water that comes down the river. Now, we're getting into channel geomorphology. You can begin to see some of the relationships of the channel geomorphology to other components



of this diagram, and the lead toward riparian studies, especially fish habitat. Also tied to the work that Chuck Dalby and Jim Robinson are doing is analysis of the historical channel changes. If you look at some of the diagrams and charts that Chuck and Jim have put on the wall, you get a sense that this is not a static river, it is a very dynamic river, especially in some areas. So tonight we'll hear about how dynamic it is; how it is changing; how it's changed over time, and some of the things that are going on relative to stabilization, bridges, and things of that kind. So, since I know this is going to take a while, I'm going to turn it over to our presenters: Chuck Dalby and Jim Robinson from the Montana Department of Natural Resources and Conservation.

2. Geomorphology Study Power Point Presentation

See Attachment A. Historical Channel Changes and Fluvial Geomorphology of the Upper Yellowstone River Power Point Presentation.

3. Question and Answer Session

John Bailey: Okay, we're now going into the question-and-answer session. You may now ask questions of anything to do with the research, directed to the researchers. The first people who may speak are the Task Force members. Questions?

Andy Dana: I guess I have a couple of questions. The first is for Jim, are you going to make an effort, if possible, to check with some people who might be able to help with your bank stabilization interpretation?

Jim Robinson: I hadn't really thought of that, but it would certainly be helpful. I would like to do that, and I had hoped that this meeting would be an opportunity to get some feedback from you as well. I think it would be very useful to sit down with people such as yourself and others, in the area they are familiar with, and learn the history. I think we need to do that, and I hope we can make time for it.

Andy Dana: Chuck, I'm just interested in how you developed your natural/human-forced channel criteria versus the human/forced-channel criteria? The reason for my question is that you showed an area with a cattle crossing that definitely has a road in front of it, which is a human constraint, but immediately behind that is bedrock. Is that a natural, or is that a human constraint? And is there a systematic way that you made that distinction?

Chuck Dalby: That's a very good question. I think there is a systematic way for making that determination. What I tried to do in applying the classification is to get around what I think is a very misleading use of channel modifications statistics. A thousand feet of riprap here is not necessarily the same as a thousand feet of riprap there, as a hundred feet of riprap here. One of the things that we've seen in the course of doing this historical modification analysis is that a single strategically placed hardpoint can have a significant effect on channel processes in the downstream reach, which is several thousand feet or perhaps a mile long. So, it's very difficult to make hard and fast determinations of the effect of a particular type of channel modification unless you put it in the geomorphic context in which it is applied. So, one of the things I guess that troubled me about, not so much the NRCS Physical Features Inventory, but how some of the statistics were used at the outgrowth. And I don't remember the exact number, but you can go up the upper Yellowstone, and you can figure out the length of bank that has been reveted and what percentage that is in the overall channel area, and then say this percent is effected. What I tried to do instead, is go to areas where—once again, not to pick on you and Jerry, but it's the perfect example [points to photo of the spring creeks area in Paradise Valley]—you can go back to the 1954 photos and look at it. If nothing had been done there, that would be an anabranching channel that has been forced into a pool-riffle configuration. I'm not saying that's good or bad. I didn't make the call on whether something was a forced channel type based on whether or not there is a channel modification or a piece of revetment in that reach. I made it based on whether or not that modification had an effect on the physical river channel. That was really the bottom line. There would be no way to practically make that determination just by going to 1999 aerial photography and looking at it. You have to have the historic sequence to see what was once there and what's there now.

Andy Dana: I'm not sure I follow what your methodology is in determining a natural human-forced channel versus a natural forced channel or a human forced channel.

Chuck Dalby: I'll take a stab at it. If you're below Livingston, and you're going along in a pool-riffle channel reach, or perhaps a plain-bed channel reach, but you're in an alluvial channel where it's free to adjust, and then, all of a sudden you've worked into a wall of bedrock. And that bedrock obstruction causes the channel to develop a pool-riffle sequence. That is a forced pool-riffle due to natural constraints. I guess the way that I came up with those two categories, you know I developed the information and thought to myself, well somebody is going to look at that and they're going to say "what about bedrock channels, those are forced channels?" But they're not alluvium, and here we're only dealing with sand/gravel channels that have either some natural obstruction effecting and forcing the channel type, or a human modification or combined human/natural modification. There again, there is not a judgment as to whether this is good or bad, it's just an assessment of what you'd expect in the geomorphic setting, the river.

Andy Dana: Last one. Hopefully this will be easier. I was interested in your observation of the calcites in the weeping wall, and I wonder whether that occurs in other areas of the river, particularly the bed? When our contractor was digging to bury barbs in the bed, he said it's like digging in concrete. If you get

below the cobble on top, it's just like concrete. If there is calcite cement, if that's the proper term, what implication does that have for channel change and morphology if that's throughout the system?

Chuck Dalby: Well, first of all, let me just make the observation that if there is stable substrate at depth in the vicinity of Armstrong/Nelson's spring creek, that's very good news. Because one of the primary concerns when you constrain a river channel is that it might decide to cut down instead of move sideways, and if that happens in a significant fashion, you've really got the tiger by the tail. The materials in the weeping wall are similar to, but not identical to, those at Mallards Rest. I've spent some time with Ken Pierce (a glacial geologist for USGS) who mapped a lot of the features that are reported on in that back Paradise Valley poster. He thinks that that may be some of the boulder lake glacial outwash, which came off the Beartooth Range down Pine Creek and Mill Creek and the various tributaries, and it's probably a restricted occurrence on that side of the valley.

Roy Aserlind: Did you use the terms "incising" and "down cutting", are they synonymous?

Chuck Dalby: They are. I think they're kind of forward descriptors. Scour, incision, degradation; they don't cut it. I don't like to use degradation because that has a connotation to it that is not meant to be applied. Incision, I think and down cutting are very big words, descriptive words. Scour is kind of a tricky term because technically, in alluvial river channels, they scour and fill annually with the passage of the flood hydrograph. A lot of times engineers are concerned about local scouring around bridges. Generally, when you talk about scour, it's a restricted, local phenomenon. When you talk about down cutting and incision that is a larger, perhaps half-a-river-mile or a-mile length of channel that you apply that to.

Tom Olliff: Chuck, it looks like Jim's work has been done by the kind of arbitrary channel reach. I wonder if you were going to correlate that to channel classification, because it seems like the modification on channel classifications would be an interesting thing for managers to know.

Chuck Dalby: That's something that we can do pretty easily because we have everything in GIS. We will do that. I wanted to have him do that for this meeting. I guess one other bit of analysis we didn't really report on is that we're applying the same type of historic analysis to the question of subchannel maintenance and longevity. We can go to 1954, map and classify all the side channels that were dry and those that were flowing, and then do the same thing on the intervening years, and come up with an analysis of how those have changed over time.

Allan Steinle: The Yellowstone Conservation District commissioned a study where they looked at the effects of channel modifications in that Laurel/Billings reach, and they found where they had a lot of modification there was a great simplification in the channel type. I guess what you would call a forced channel; where there was a lot of forced channel type, there was simplification. They seemed to correspond. Did you see anything similar to that, where you had the forced channel types here? And if you did or didn't, would you care to speculate why?

Chuck Dalby: We haven't looked at that in detail yet. Some of the effects are subtle enough that they don't just leap out at you, so I prefer not to speculate on that. But I think one of the things that we do kind of notice is that there is a contrast between pool-riffle and anabranch channels versus plain bed, cascade, and bedrock. Those latter three channel types have very little if any large woody debris in them. They generally, at least plain-bed channel types, don't have much in the way of gravel bar accumulations or hydraulic variability in the pool-riffle sequence. In some ways, I think you can use the plain-bed channel type as a model for one possible endpoint of a heavily reveted, constrained channel.

Bob Wiltshire: Chuck, this is obviously not your first professional experience with this kind of work, and associated with that, you bring a lifetime of experience and learning with you to this process. You indicated to us, as part of your presentation, that you were rather surprised about the change in channels through the Livingston area. What I'm curious about is, is there anything else you found that surprised you?

Chuck Dalby: You bet, there are several. We've had many surprises on this project. One surprise, relative to the channel types is that when most of the people working on various aspects took a real look at those plain-bed channel types, we recognized them as being very stable. But, when I can sit down with 1948 and 1999 photographs, and see the same rocks in the channel that haven't moved, and also looking at trees on the banks and other physical features that haven't changed—you know the trees are bigger, but it's the same tree—that's amazingly stable. I remember my introduction in this process, the so-called Sediment Workshop, several years ago. We talked about how different people view and define channel stability. To a landowner or a property owner, a stable channel is a plain bed channel. It's there, and more likely than not, it's always going to be there. At the other end of the spectrum, is a more dynamic, geomorphic definition of channel stability where the channel moves around but it does it in a regular, predictable fashion, which preserves its average dimensions. But that's a real surprise to me that there are stable channels, that stable.

Roy Aserlind: Is the data that you have already collected, will that be, in its entirety, amenable to your future bell hypothesis testing for downstream effects, or do you have to collect more?

Chuck Dalby: We don't have to collect more. We have a lot of data management and interpretation to do to make sure that we set up case histories that are statistically valid. A problem that I ran into right off the bat [was relating things to channel modification]—and I didn't recognize it immediately, and it's potentially a fatal flaw, especially when you're comparing low-flow water-surface widths in anabranching channels, and you've got several sites and you're trying to compare what's happening above and below. It turns out that what effects the lateral distribution of flow in those channels is completely unrelated to any channel modification. It has more to do with natural processes and which channel is currently in favor. Under those circumstances, if you don't recognize that, you can have an apparent change in water surface width that you would attribute to channel modification, that doesn't have anything to do with it. It has to do with flow distribution in the upstream channel. So, part of the information is there and most of the basic data is there, but we've got some focused interpretation still to do.

Andy Dana: I'm not sure if this is a general session or a research question but, you didn't talk about one thing you mentioned in the written materials, and that's floodplain stripping, which I found interesting. Maybe this is more Mike Merigliano's bailiwick, but I'm curious as to whether in rivers with more entrenched channels, like the Yellowstone, whether they're more inclined to do that floodplain stripping? As I gather that term means essentially just stripping the bank of all vegetation. Is that more likely in these entrenched river systems, than in rivers that tend to spread more laterally in their flood plain? And then secondly, if that's so, is there anything that you can say generally about the geomorphology related to that floodplain stripping? And then, finally, what might that say about soft engineering on the Yellowstone?

Chuck Dalby: In the report that Task Force members were supplied with, we included some references to the effects of vegetation on bank stability and floodplain stability. The term floodplain stripping is generally applied not so much to vegetation on the riverbank, but to when you have riverbank floods and significant flow across the floodplain. If you have materials that are susceptible to erosion (particularly soils with a high sand content) and vegetative cover for whatever reason is not sufficiently dense to bind that together, then, as the flood flows over the flood plain, it peels off what remaining vegetation is there and it has a readily available source of fine silt. Jim Swift (one of the USGS's premier geomorphologist/modelers of analyses of the Clark Fork River) clearly shows that, under some circumstances, that kind of floodplain stripping and introduction of sediment can cause channel instability and basically huge meander channel changes as kind of a cascading, snowballing process. We haven't really looked specifically at that on the Upper Yellowstone. My sense is that there may be some places, particularly in the anabranching, braided channel type that could be susceptible to that. Certainly in the incised channel reaches where plain bed and some of the pool-riffle reaches, you don't frequently, and sometimes even in 100-year flood conditions, get up out of their channel and onto what was once the flood plain.

Andy Dana: It occurs to me that in a lot of the reaches in our area, whole cottonwood forests disappeared, and is that a type of floodplain stripping?

Chuck Dalby: Yeah, it is. And we haven't looked at this carefully and didn't talk about it much in the report tonight. The subject of riparian vegetation, and what role the trees and shrubs and forbs and all the other things play in terms of maintaining bank stability, is very important. There has been a lot of research done that shows that it can be very critical. There has also been work done that shows that, particularly with cottonwoods, if you have an incised channel and it is down cutting somewhat actively, once you get down below the root zone, you've lost that binding strength of the root mass and the tree then becomes essentially a weight on the bank and a destabilizing force. So, I think, certainly the channel reach from Mission Creek to Springdale, which has a couple of fairly large anabranching braided sections, saw many thousands of board feet of cottonwood go down the channel, it's impressive.

John Bailey: I'd like to open it up to the public now for questions.

Bill Moser: You counted the rocks, right?

Chuck Dalby: Some rocks.

Bill Moser: Okay. I'm interested in the velocity drop out ratios, that water will drop a certain size back out and the percent volume, if you went out and just scooped ten yards of material out of the bed of the river, or because it's alluvial anywhere in the Paradise Valley, you scoop out ten yards, what percent would be fines, which would be on the way to Baton Rouge, what percent sand, peel off, three-quarter minus, three-quarter plus, cobbles and boulders? Can you, either in your report or in your data, come up with the volumes and the drop out rates for sizes of that nature?

Chuck Dalby: Within some pretty constrained channel reaches—where we have a lot of information on surface particle size, bank material composition, and also, we haven't been able to do this yet, but we just got the newly revised digital NRCS soils inventory—I think we can make some generalized statements that break out what percentage at least of the active layer (the top ten feet of the flood plain and river channel) in general terms, what those break outs are. To do something like that precisely, you would need a hollow stem auger or ground penetrating radar, and that's beyond the scope of what we're really going to look at. In terms of taking riverbed material and estimating the velocity or shear stress at which a whole size distribution of particles or individual particles would be picked up and transported, we can do that. That's part of the USGS study, some of that analysis is incorporated into their sediment transport modeling. We're also going to be making some, what I would call, critical shear stress calculations for different representative types of sediment to see what kind of forces and flood flows it takes to move those particles.

John Remus: Could you briefly define what a statistical, valid case study is; how it's defined? And then I have another one after that.

Chuck Dalby: There are a couple of different ways that you can use statistical inference to draw conclusions about how some stress on the river has affected the channel. One way to do that is to go to a streambank in a single-thread channel (where you have similar channel type grouping all through that reach) and measure hydraulic characteristics above and below that revetment, and use that strategy to keep all the other things equal so that you're comparing and isolating the difference of that channel revetment. That's a pretty simple model, and it's a very simple model in comparison to dealing with multiple-thread and anabranch channels. I think to develop a credible analysis for those channel types, you can't just look at the above-and-below aspect, you also have to incorporate into that analysis a before-and-after comparison. There's one very simple before-and-after comparison that you can make, and it's one that we will do. We'll go into the Livingston area, using 1948, 1949, and 1954 photography, and measure a whole bunch of channel characteristics, which we will then summarize and compare with the same channel characteristics measured in 1973, 1987, and 1999 and wherever else we can look for trends over time and associate those back to constant factors. I don't know if that answered the question.

John Remus: Yes, it did. The second question is on these large eroding banks, you said that specifically to the sediment budget, and I was wondering if that was on an event basis, or a long-term

trend basis, and whether or not that was based on the total sediment yield, or just the yield in the immediate area?

Chuck Dalby: Those are both very good questions. The information presented tonight and in the report is the 1948/49 to 1999 total amounts. The next comparison that I'm going to make is working with 1973 and 1976 to see what portion of that is attributable to the 1974 flood versus what portion is attributable to the 1996/97 floods. If you go to the weeping wall photo sequence that's posted on the wall, and just look across that, it looks like in 1987 there's not much of a big gravel bar downstream from the weeping wall, but it is certainly there in 1999. I suspect that the 1996/97 floods were much more significant events and sediment transporters than was the 1974 flood, in part because of something called "event sequencing". The 1996 flood kind of tenderized the banks and warmed things up for the 1997 flood, which had both high flood discharge as well as something like a three-week period of flow at a significant sediment transport stage. So what I suspect is that most of those growing volumes did come off in 1996 and 1997, but we still need to do the analysis.

DeWitt Dominick: I'm curious to know, as far as the channel types and the forced channels and their human manipulation of the river—a lot of emphasis has been on longitudinal bank revetment, but how about parallel to the river (berms), are there any changes that you've seen based on lateral encroachments from roadways or encroachments that are cutting the flood plain across perpendicularly? In fact, does that type of human manipulation in any way force one channel type into the next type upstream or downstream?

Chuck Dalby: I think there are those types of modifications and revetments. Most of the highway bridge approaches kind of transect the flood plain. Whether or not those types of changes have resulted in constrictions that cause changes in channel type, I can't answer that.

Tom Pick: I have two questions, a yes or no one after this. You use this example over here of this first poster on the left [poster of the City of Livingston reach], you indicated that you were surprised you hadn't seen some down cutting there, given that there's a fair amount of lateral constraint in place, so I guess with the degree of constriction there, offered by the interstate bridge, wouldn't you somewhat expect to see a channel at least maintaining or the channel raising? How long do you see aggregation in that instance or any down cutting below that constriction with the increase in velocity?

Chuck Dalby: I think Tom's question was that, in the vicinity of the Interstate-90 Bridge, there's quite a bit of constriction. It would seem perhaps that local scouring has moved material out that's been then redeposited in the channel downstream and it's not immediately obvious that that has happened, but I haven't taken a careful, systematic look at that. What I think it might point out, and we don't have good numbers, although I know the gravel mining operations on Siebeck Island removed significant quantities of sand and gravel from the channel there. Typically, proximate to those operations, if they're large scale, you see channel incision and down cutting but, and there probably has been some, I mean I'm sure some has occurred, but the material in the channel bed is very coarse, and once the finer particles are winnowed out of the bed material and removed from the channel through scour, you develop a pretty stable armor that really is resistant to further incision, and I suspect that is what's happening in that area.

Tom Pick: My second question is brief. Do you intend to calculate entrenchment or incisement ratios, and characterize differences in the degree of incision?

Chuck Dalby: In terms of the channel classification that we did—and I should point this out—there are two approaches to science and our approach to channel classifications was kind of a blend of both of them. By today's contemporary standards, we cheated. We went in the field and we looked at aerial photographs and we used our eyes. The purely GIS approach to that is to layout these complex terrain models and then collect thousands of data points, run your program, and have the computer software tell you what the various channel classes are. We should do that. But we did use a quantitative approach, and we have generally categorized into low, medium, and high, the levels of confinement and entrenchment. One bit of analysis that I think is down-the-line of what you are talking about, I'm going to try and use, to allow local scale variations in channel incision and aggregation, and that is to take the

detailed GPS profile that we've got, which is basically every break in slope on the water surface between Mallards Rest and the Ninth Street Bridge, and take that and merge it with the two-foot and four-foot contour mapping, and then do a profile comparison in the areas where you have a fairly uniform sloping floodplain surface, and use that as a datum, and then compare fluctuations in bed elevation with that. If that analysis works, we will be able to show trends, small-scale local trends in aggregation and degradation or down cutting as you go down the channel. I don't know if other folks have gotten a sense, but when you float from Mallards Rest down to the Pine Creek Bridge, and for that matter on down to Livingston, I get the sense as you go down the channel that, in some areas, the water surface is maybe four to six feet from the top of the flood plain. These are in unconfined reaches, but as you go in through that same channel reach, the flood plain seems to maintain a uniform slope, but in some places, you're 10 to 12 feet down. It's possible that that difference between low flow water elevation and floodplain elevation is a measure of how much the channel has down cut or degraded.

John Bailey: I'd like to take a five-minute break, and then we'll go into the general discussion session.

4. General Discussion Session

John Bailey: I do want to make one statement, and that is that I believe that we're going to have to have another geomorphology meeting sometime in the future. I'm not sure what the format of that meeting will be, but when Chuck and Jim get the rest of the reaches and aerial photo analysis done we need to meet again. I think we need to present these missing products/findings to the public and give the public a chance to comment on them. I also think that it's important for us to be further educated on these geomorphology concepts and then give some input as to what some of these things may mean. I heard Chuck make some statements about Livingston this evening, yet he hasn't even looked at the photos through Livingston yet (only to the Interstate bridge); so I'm going to hold my comments until I get some additional information on the subject. But, I plan to challenge at least one of Chuck's statements presented here tonight. I'm not sure what format we'll do it in, or how we will be able to fit it into our already busy meeting schedule, but I do feel that at some point, we are going to have to do something publicly, whether it's a Task Force meeting or some other public event to present that data. So Chuck and Jim, you will be back on the docket again.

Liz Galli-Noble: May I just ask you Chuck, when do you think that might be doable? Are we talking after March, April, before that? Can you give us an indication of when you think you might have that data available for a follow up presentation?

Chuck Dalby: I think March is realistic. That and a bunch of other information as well.

Jim Robinson: What data are you talking about?

Chuck Dalby: Basically, continuing this analysis.

Jim Robinson: I hope to have the mapping phase done by February 15, 2003.

John Bailey: I just want everyone here to understand that I do believe that we're going to have to have some type of a meeting to present additional geomorphology data, and we're going to have to squeeze it in somewhere.

Now, we'll go in to our general discussion session and I'll open it up to the Task Force members first. Any comments about this data?

Brant Oswald: Actually, some of this may come back to asking Chuck for some comment on research again. One of the things that has been forming in my mind and one of the things that I thought was most interesting, was the discussion you had about linear or non-linear responses to stress. It seems to me that one of the things that's most interesting that came out tonight pertains to cumulative impacts and the fact that non-linear response is exactly what we may be looking for. I think that this is one of the things that ties in a lot to what we're looking at, and what a lot of us are concerned about. A general question: to what extent will some analysis be done? Is there a precedent in the literature, have other river systems

been studied in that basis and really seem more developed in terms of what a critical point might be in terms of some of these processes?

Chuck Dalby: We are going to try and do that, Brant. But the standard geomorphic literature-driven approach is to (1) take the various channel types, and channel patterns, and take the hydraulic information that describes the channel, relationships between width and depth, and velocity and depth, and (2) plot those on so-called threshold diagrams that allow you to identify channel pattern thresholds—usually as a function of the size of the bed material and the slope in the channel. In some areas, there are clear enough distinctions that you can group these different clusters of channel hydraulic information on a channel type specific basis. For example, you may find that all the heavily reveted channels or something applied in one area are a channel type, and all the natural unaffected channels have a different relationship. That's one way to do it. Oftentimes, it is inconclusive due to natural variability. I think a much better approach is to use an empirical approach and try to muddle through what amounts to a retrospective, cumulative effects analysis. You know, let's pretend that this group had gotten together after the 1974 flood, and had these same discussions, and then, in the ensuing 20 years what happened to the river channel happened. We can go back, we can look at early points in time, and what the channel type and characteristics were. Then we look at the level of different types of modification and how the channel has changed up through the current day, and if we see changes in the channel type, if we see what has been a purely single-thread channel adopt anabranching or braided patterns, that might be an indication of threshold change. We are going to pursue that.

Laurence Siroky: At the last Task Force meeting [November 19] we heard information about defining the 100-year flood plain. From what Chuck is saying in his geomorphology presentation, it sounds like for some sections of the river you can identify the location of the 100-year flood plain with some certainty; but in other sections of the river—sections that are constantly changing—identification of that 100-year flood plain might be different two years from now. That's something we're going to have to look at when we begin adopting those regulatory lines for the 100-year flood plain. For some sections of the river, we may have to allow for that natural variability or whatever causes that variability; we'll have to account for that change, that more frequent change in those sections of the river.

John Bailey: Early on, we did the Physical Features Inventory. Now Chuck is telling us about various bed and bank materials. Do you think that there will be a way to have different types of permitting system on the Yellowstone, based on these different components? I've been telling various Corps people that I thought permitting should be tied somewhat to slope, but now it seems that permits for the Yellowstone should be tied to reach classification. It may be more logical, if we try to do that as the Task Force, to help us understand those classifications better and what may or may not work. It may only be a recommendation to the Corps, that they be looking at classification in their permitting process. Because those of us who know the Yellowstone are aware that if you build the same thing in two different places, one is going to be over built, and one is going to be under built, and neither one of them will do anybody any good.

Andy Dana: Chuck and Jim—don't take this as a criticism of what you've done and what you're doing, because I think it is very impressive—from my perspective sitting here, I did not hear a lot of information that I can take to the bank in terms of evaluating cumulative impacts at this point. Maybe that will come with your follow-up presentation in March. I realize that you're building blocks here, as you're going to run the models and build the models in the future, but frankly I'm not sure that if we're going to come up with recommendations about cumulative impacts that what I heard here tonight is going to be easily translatable to those recommendations. Just a comment.

Allan Steinle: Chuck, where are you going? I'm going to follow on what Andy said. I understand a lot of what Andy is asking for. In your comments, if I understand them—you can't avoid this—are you just getting into what you call element number 4, now? [4. Analysis of Historical Channel Processes and Cumulative Effects of Channel Modification]

Chuck Dalby: That's right.

Allan Steinle: So, it should be coming?

Chuck Dalby: Yes.

Andy Dana: I guess the point is that it may be coming, but will it be coming in a form and at a time the Task Force can use it?

Allan Steinle: Good question. And I also want to follow up on what John was saying. Earlier Tom Pick mentioned correlating the channel classification with the physical features inventory. I know you said you could do it, but were you also saying that you would do that?

Chuck Dalby: Yes, we will do that.

John Bailey: Comments? I will now open it up to the public for any general comments on this presentation, or what it might mean to what we're doing.

Bill Moser: I'm concerned about looking at 25 percent, 35 percent plus or minuses when you're moving large amounts of materials downriver. What kind of validation are you going to have for those kinds of figures?

John Bailey: Well Bill, until today we had no figures. As a Task Force we have to be very careful of how we utilize these figures—25 or 30 percent variance. But these are the first figures we've seen, as to what those large sediment sources have been contributing. I think that the most interesting and important thing that we need to see is what they contributed in 1996/97 floods. Because Chuck indicated that probably most of it came then, versus the previous 50 years. And another thing that came out in this presentation to the Task Force that I think is very important, is that the big sources of all this heavy, big, bed-load rock does not move very much in average events, and the really big change is happening when we have these 100-year floods. When we're having the normal events, when we don't have a major event, we're building that channel. From 1900 to 1973, we had one 100-year flood. In 1974, 1996, and 1997 we had three in basically less than 25 years. That's interesting. I think Chuck's going to have to build on that data, because one of the concerns that I came here with, and it was more reinforced tonight, is that I am not sure how we, as a Task Force, can plan for 100-year events. That seems to be when the major change is occurring, and not so much during other flows. In my mind, I'm somewhat wrestling with how we're going to deal with that. We all remember some of the effects of those two big floods. And in the 1974 flood, what I remember as a fisherman is we lost a lot of side channels and the river actually cut down. The biologist at the time made the comment that that was a flood that actually cut the channel deeper and consolidated. Now, I don't know if you can see that in the photos, but it was a comment made based on no science that I know of, it was just observations. I do know that just upstream from Nelson's Spring Creek, for part of that there were about five channels that have consolidated into one or two.

Duncan Patten: I was going to address your comment about how you can relate to 100-year floods, or how you can adjust to that way of thinking. I was just going to point out that I think what you're going to have to think about into the future is that climate is going to have more extremes. In other words, the climate is becoming more erratic, wetter wet years, and drier dry years, versus the earlier part of the 20th Century. So, yeah, we may have more frequent 100-year floods, we may have more extended droughts, and that's something that global climate monitors are now looking at, as we find the Pacific heating up, and what they call Pacific Oscillation, and things like that, which is like in 20-year cycles. That's when you really begin to build into your thinking that extremes are going to become the norm. It's a pleasant thought.

Jerry O'Hair: Well, I guess I was really surprised with the amount of material that is coming off the weeping wall (in particular) and the other banks that are eroding. I was surprised by the fact that it's, to me, very little. When you think about 350,000 cubic yards over a 50-year period, that's almost 7,000 yards a year. It just absolutely blows my mind that it's that small an amount of material. Maybe to some

people that's a large amount, but it just seems like it is a very small amount to me. I have no reason to doubt the figures, but I was really surprised at that amount.

Duncan Patten: Again, Jerry, think in extremes. If you're averaging that over seven years that's true; but how much of that, as John points out, came in 1996/1997; 80 percent? And Chuck Dalby thinks that they're going to find out. The river might deal with it differently if it was averaged out to 7,000 a year versus that much in two years, in terms of what's going on downstream. I mean, again, it's these extremes that they're looking at, averages ecologically mean very little, unfortunately.

Jerry O'Hair: But along with that, even 400,000 cubic yards a year off of that bank or those other banks, seems like a very small amount. I guess I have to relate it back to personal experience of moving that much material and then having the river move it right back in there in a one-week period. It just seems like a truly small amount.

Bill Moser: Procedure – It's very difficult to absorb a huge amount of this information in one night and come up with the questions that really need to be asked. Some of these questions are not about the facts, they're about the causes; and so, what kind of procedure is there for going back and looking at the past presentations and getting answers to questions and that?

John Bailey: I don't believe we're going back, due to time constraints, but the plan right now for the Task Force is: we have two meetings in January, two in February, hopefully one in March. It's sounding like having only one meeting in March is becoming more difficult to stick to. The chair is trying to leave the country in March, and originally tried to leave the country in late February, but as you can see, we now have a meeting in late February. Because we haven't heard all the data yet it is hard to speculate, but in April, we have been talking about having several broad discussions about all the research findings. Until all the data is in, you can't correlate it all. As we move into the fisheries and some of these other studies, I think that we'll be trying to tie back to the geomorphology study and various things that we have been shown on these maps. But time is a major constraint—we're supposed to be done by August—and it is going to make it very difficult to go back to all these studies. There is also the idea of a roundtable that has come up; to bring all the researchers together to integrate the data. The concept sounds very good, but I've not quite figured out if we can bring all this data back together and then tie it together. The TAC, and Duncan may have a better idea how to do this. I think the Task Force members haven't seen enough of the data to really understand how to do that, but your question is one I've been asking for some time now. Liz and I talk about it quite often, and it concerns me. We are going to be trying to bring a lot of stuff together and that's probably going to be April and May 2003. We seem to be on a two-week meeting schedule, and we'll probably be that way all along, except when I'm traveling. And hopefully I get to travel, because otherwise my business is going to suffer.

Bill Moser: What I'm getting at is not so much of what the data is, but how the data is asked for. I mean, one map, just to take you to the snowmelt scenario rather than rain. We're talking about half of the weather above 8,000 feet. Well I've only been coming up here since 1962, and I've only lived here 20 years, but the weather comes into the Paradise Valley at 6,000 feet or 6,500 feet, at least 80 percent of the time, the winter weather. And so, if you're looking at 8,000 feet versus 6,000 feet, the number that came forward was 50 percent, could very well be 85 to 90 percent. The other end of that thing is, nobody in that presentation [referring to the November 19 presentation] mentioned sublimation. And we know what condensation is, and evaporation, sublimation is where a solid, snow, or ice goes directly to the vapor form without being a liquid. And we see that in the Paradise Valley constantly because the snow goes away and there's no wet spot on the ground. And so, if you're not looking at the percentage of precipitation above 6,000 feet or whatever that is sublimating, we don't have a very good model at all as to how these snows and the runoffs are going to effect the thing. The other end of it is, cause-wise, you look at what were the week weather patterns immediately preceding these four years of 1874, 1996 and 1997, and that gives you the causes of the flooding. And then you compare that to a low year, and you may come up with significantly different signs than what you would come up with if you weren't looking at them at all.

John Bailey: There are lots of truths and there are going to be lots of things we will not have, but we have a lot more than anyone every expected when we started.

Andy Dana: Just another quick request of Chuck for his second round. Chuck when you come back in your second round, I think it's important for the Task Force for you to look at the standardized questions and to create some responses. This is important because they are the same across all of the disciplines and it allows us to bring some unity to all of these issues, even though they are somewhat arbitrary questions, but it does I think help us at any rate. So if you wouldn't mind just taking a look back. You've answered some of these questions in the context of your presentation, but others I think you didn't.

Liz Galli-Noble: I'll just make a comment. I was going to ask the same of the USGS. There were a couple standard questions that they too didn't address in their November 19 presentation.

V Other Business

1. 2002 Annual Report

John Bailey: If there are no other comments, I'd like to move on to other business tonight. There are various things sitting on the table but one of them is the *2002 Annual Report*. This draft was just recently put together, and I haven't seen it until tonight. I would like to recommend that you read this and give any comments to Liz. If we have to, we will schedule yet a third meeting in January to deal with this thing. Liz said she didn't change it much, and highlighted everything that was changed from the 2001 report. Maybe the January 7th meeting will be short, but I doubt it. Otherwise, if we can't deal with it at the next meeting, we will have to schedule a third meeting for January to address the annual report. So, hopefully, people can read this and maybe we can deal with this individually, and then maybe take a vote or something like that at the next meeting. If there are a lot of comments concerning the annual report at the next meeting, we're going to have to have a third meeting in January.

VI Schedule Next Meetings

John Bailey: The Task Force talked about possible new dates for meetings in February, and they have now been finalized with the researchers for: February 11th and February 25th. Now, to schedule the March 2003 meeting.

Liz Galli-Noble: You suggested March 25th.

John Bailey: March 25th, is that doable? Good, it's a date. That's a Tuesday night. That's the last week in March.

John Bailey: Is there any other business anybody has? If not, we are adjourned until January 7th. Thank you.

Tuesday, January 7th, 2003, Riparian Trend Analysis
Location: Yellowstone Inn

Tuesday, January 21st, 2003, Fish Population Study
Location: Yellowstone Inn

Tuesday, February 11th, 2003, Wildlife Study
Location: Yellowstone Inn

Tuesday, February 25th, 2003, Fish Habitat Study
Location: Yellowstone Inn

Tuesday, March 25th, 2003, Historic Watershed Land Use Study
Location: Yellowstone Inn

VII The meeting was adjourned at 10:20 p.m.